Population Movement in the Tohoku Region after the Great East Japan Earthquake Disaster

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Abstract This paper clarifies the demographic change in the Tohoku Region after the "Great East Japan Earthquake Disaster". Especially, we tried to show the geographical characteristics of the out-migration generated after the natural disaster and human disaster. The dead and missing persons by the earthquake and tsunami are concentrated in three prefectures ; Iwate, Miyagi, and Fukushima in the Tohoku Region. Many victims are found in the area along the Sanriku rias. It is, however, a distinctive feature of the disaster by the "Great East Japan Earthquake" that the damage of the tsunami was not limited to the Sanriku rias. The serious damages were caused by the tsunami in the area of the sandy shore in Miyagi Prefecture and Fukushima Prefecture. The Pacific Coast Region (Hamadori) in Fukushima was also struck by more than 10 m high tsunami, and the electric generators of the Fukushima Daiichi nuclear power plant were destroyed by this tsunami, and caused unprecedented nuclear disaster. I analyzed the change of each migration pattern of 6 prefectures in the Tohoku Region by using the data of "Basic Resident Register". In Miyagi and Fukushima, we found a large excess of out-migrants among all age groups. Especially in Fukushima, there was large excess of out-migrants in the child generations and their parent's generations (from 25 years to 39 years old). In Miyagi and Fukushima, the numbers of net out-migrants of 20's increased greatly. Women and their children moved farther compared with men. This seems to be the manifestation of the strong desire to avoid the influence and contamination by radiation on women and children as much as possible.

Key words : disaster rate, out-migration ratio, age profile of migration, out-migration from Fukushima

1. Outlines of the human damage by the earthquake and tsunami

A massive earthquake of magnitude of 9.0 occurred on March 11th, off the Pacific coast of the northeastern part of the Japanese main land, causing devastating damages. The Japan Meteorological Agency named this earthquake "The 2011 off the Pacific coast of Tohoku Earthquake". We simply call this earthquake "The Great East Japan Earthquake". The Great East Japan Earthquake brought about the biggest influence on the Tohoku Region in Japan. Around 18 thousand people died or missed and massive people were moving out to escape from the tsunami and the accident of the nuclear power plant which occurred after the earthquake.

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Japan has been called the disaster country. Natural disasters such as earthquake, typhoon, flood and land slide due to heavy rain have been the cause of many deaths and casualties until now. Historically, the seismic hazard which sacrificed the greatest victim in Japan is the "Great Kanto Earthquake Disaster" occurred on September 1st, 1923. The magnitude of the earthquake was 7.9 on the Richter scale, and the number of victims was estimated over 105,000 people around Tokyo and Kanagawa Prefecture (Moroi and Takemura, 2004). Since the magnitude of the "Great East Japan Earthquake" was 9.0 on the Richter scale, the "Great Kanto Earthquake" was smaller in the magnitude. However, the "Great Kanto Earthquake" resulted in more victims because the stricken areas were the major metropolitan areas in Japan where population was heavily concentrated. Moreover, it is the feature of the "Great Kanto Earthquake Disaster" that about 90 percent of the victims was killed in the fire which broke out after the earthquake.

In case of the "Great East Japan Earthquake Disaster", there were few victims directly caused by the earthquake itself, but many were killed by tsunami (Table 1). Historically, the Tohoku Region has been struck by many tsunami and many people fell victims by these tsunami (Table 2). It seems that the number of the victims of the "Great East Japan Earthquake Disaster" is almost equal to the number of the victims in the "Meiji Sanriku tsunami" in 1896.

Nationwide distribution of the people killed and missed by the "Great East Japan Earthquake" is shown in Fig. 1. While death and missing rates are higher in Iwate, Miyagi and Fukushima, the distribution of the death and missing people spreads throughout Eastern part of Japan along the pacific coast as it is described by its name ; "Great East Japan Earthquake Disaster".

Fig. 2 shows death and missing rate of each municipality in these three prefectures. Onagawa Town in Miyagi shows the highest death and missing rate (91‰). Otsuchi Town in Iwate has the second highest disaster rate. Many personnel of this town office fell victim, and the Mayor of Otsuchi Town also passed away by tsunami. Rikuzentakada City in Iwate (77‰), Minamisanriku Town in Miyagi (48‰), Yamamoto Town in Miyagi (41‰) and Yamada Town in Iwate (41‰) follow subsequently in the disaster rates. Most of these city and towns are

Table 1 Victims by the "Great East Japan Earthquake" in three prefectures

	Iwate	Miyagi	Fukushima	Total
Death and missing	6,099	11,501	1,838	19,438
Population in the coastal area (2010)	313,664	1,708,363	671,562	2,693,589
Death and missing rate (%)	1.94	0.67	0.27	0.72

Data : Japan National Police Agency Nov. 2, 2011

Table 2 Victims by tsunami in the past

		Iwate	Miyagi	Aomori	Hokkaido	Total
Meiji Sanriku Tsunami (1896)	Death	18,157	3,387	343	6	21,893
	Population in the coastal area	76,105	29,995	–	–	–
	Death rate (%)	23.86	11.29	–	–	–
Showa Sanriku Tsunami (1933)	Death	2,667	307	30	13	3,017
	Population in the coastal area	130,846	35,964	–	–	–
	Death rate (%)	2.04	0.85	–	–	–

Source : Kawata (2010), p. 38 Table 1–3

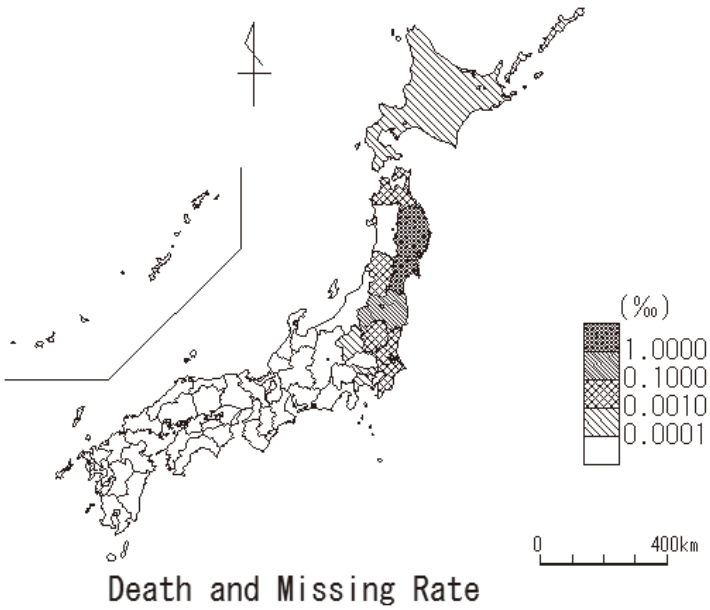

Figure 1 Deaths and Missing rate in the Earthquake Disaster
Data : Japan National Police Agency, Sept. 2012
Death and Missing rate (‰)=(number of death and missing)×1,000/(population in 2010)

located in the Sanriku rias, and many victims were found again in the Sanriku rias, in spite of the past experiences of tsunami disaster and the lessons learned from the past.

It is, however, a distinctive feature of the tsunami disaster by the "Great East Japan Earthquake" that the damage of the tsunami was not limited in the Sanriku rias. Since the length of the seabed shifted by the earthquake reached about 450 km from north to south, the damaged

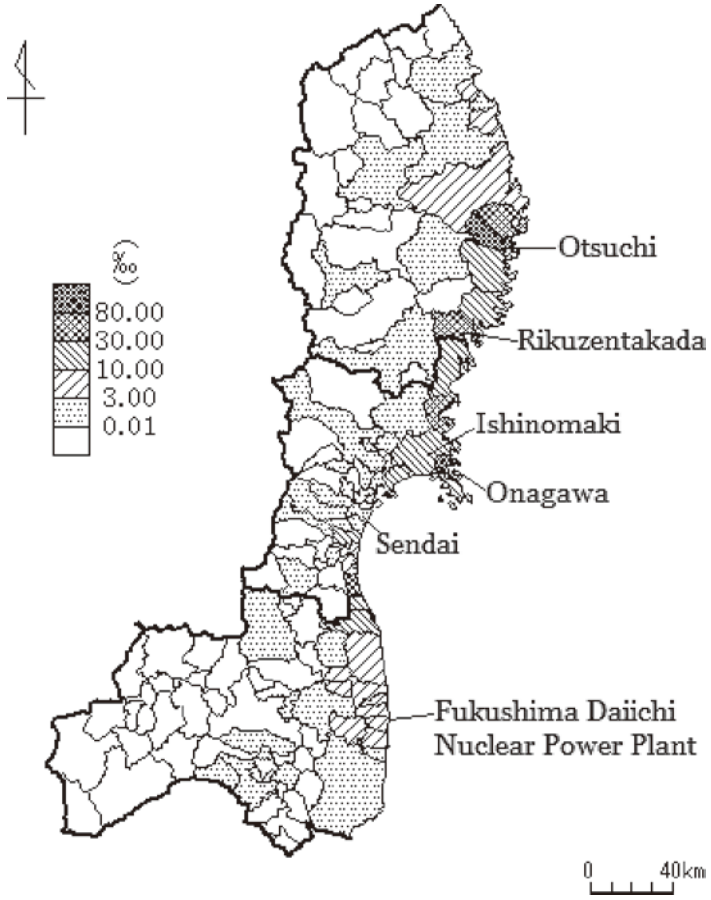

Figure 2 Death and Missing rates by Municipality in Iwate, Miyagi and Fukushima prefectures
Data : Fire and Disaster Management Agency of Japan, March 2012.

areas by the tsunami spreads to the south of Sanriku rias, that is, from sandy shore in the Sendai Bay to Hamadori coast (region along the Pacific Coast in the Fukushima) and farther coast. The serious damages were caused by tsunami in the area of the sandy shore of Ishinomaki City in Miyagi. The number of death and missing people in Ishinomaki City amounted to 3,734 persons. It is the largest casualties as one municipality. The number of victims amounted to more than 1,000 persons in Kesennuma City and, in Higashimatsushima City which adjoins Ishinomaki City. In Natori City in the south of Sendai City where the Sendai Airport is located, the number of victims amounted to around 1,000 people.

The Hamadori Region in Fukushima was also struck by more than 10 m high tsunami, and the electric generators of the Fukushima Daiichi nuclear power plant were destroyed by this tsunami, and caused unprecedented nuclear disaster.

2. Population movement in the Tohoku Region after the Earthquake Disaster

2.1. Out-migration from each prefecture in the Tohoku Region

Statistics Bureau of Japan has released the data of the internal migration based on the Basic Resident Register every month. This data has been totaled for every former address [Japanese who submitted the notice of a change of address] about all prefectures and big cities. The movement of a temporary evacuating person is not included. However, because it is thought that movement by having changed work place or attending-school place by the earth-

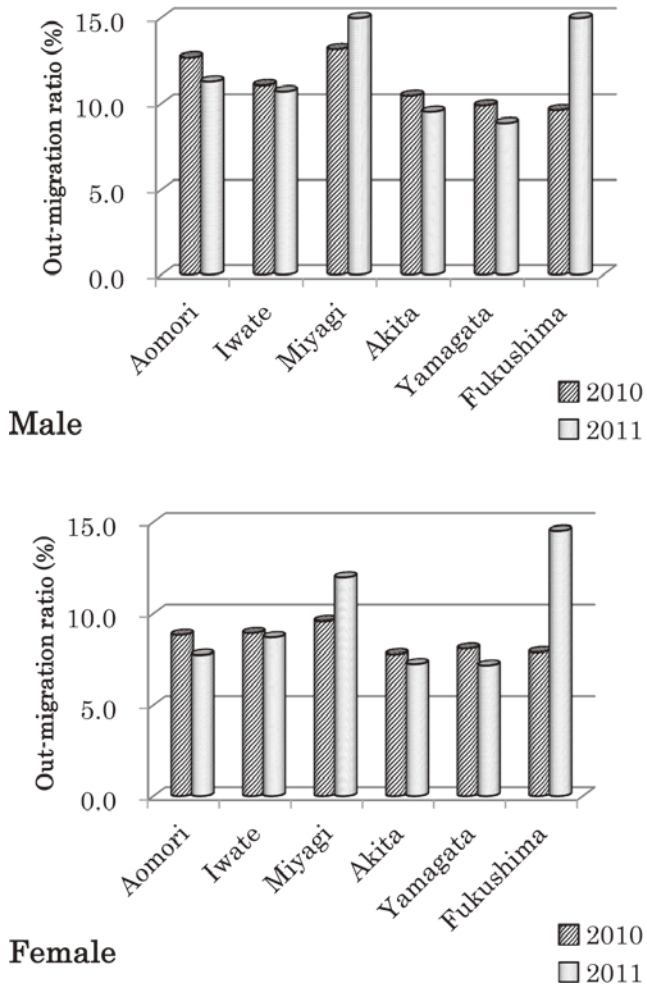

Figure 3 Out-migration ratio (‰) from each prefecture (2010 and 2011)

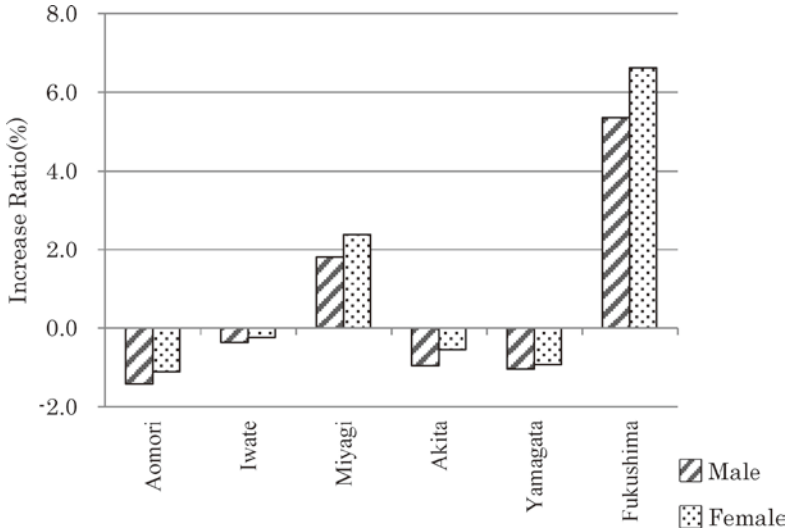

Figure 4 Change of out-migration ratio (‰)

quake, tsunami, and a nuclear power plant disaster should be included, the influence of "Great East Japan Earthquake" must appear in this data. Moreover, it is precious data in order to project a tendency of future population movements.

Fig. 3 shows the out-migration ratios (number of out-migrants×1,000/prefectural population in each year) from March to June for 2010 and 2011 respectively. Upper side is male out-migration ratios and lower side is female out-migration ratios. As you can see, the out-migration ratios of male are higher than those of female. When numbers in 2011 are compared with those in 2010, the out-migration ratio decreased in Aomori, Iwate, Akita, and Yamagata, but it increased in Miyagi and Fukushima. Especially the increase in female out-migration ratio in Fukushima is outstanding.

Then, Fig. 4 shows that the differences of out-migration ratios between 2010 and 2011. The increase of the out-migration ratios in Fukushima are considerable, especially the increase of female out-migration ratio is much larger than that of male.

2.2. Monthly change of out-migration from Iwate, Miyagi and Fukushima

From Fig. 5 to Fig. 7, we compared monthly changes of out-migration trends from Iwate, Miyagi and Fukushima before and after the occurrence of the earthquake, tsunami, and the accident of nuclear power plant. We have to take into consideration here that the use of railroad, expressway, and air route which connect the Tohoku Region to the Tokyo metropolitan area, were completely blocked by the earthquake and tsunami during March, 2011. Furthermore, it is important to note that the disaster happened at the end of the fiscal year and school year. Usually, in Japan, internal migration movement will be a peak in March when people move due

to entering university, graduating from a school, getting a job, and transferring to the different office. Although March is such a month that migration movement concentrates most, in Iwate and Miyagi, the amounts of out-migrants in March 2011 were much less than those in 2010, as a result of the transportation obstacle.

In Fukushima, however, it is almost same number of out-migrants that in 2010, and the number of female had exceeded that of male. It is because Fukushima is close to the Tokyo

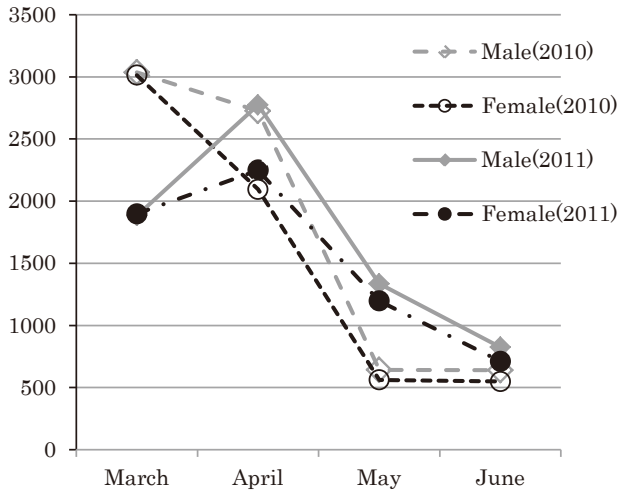

Figure 5 Number of out-migrants (Iwate)

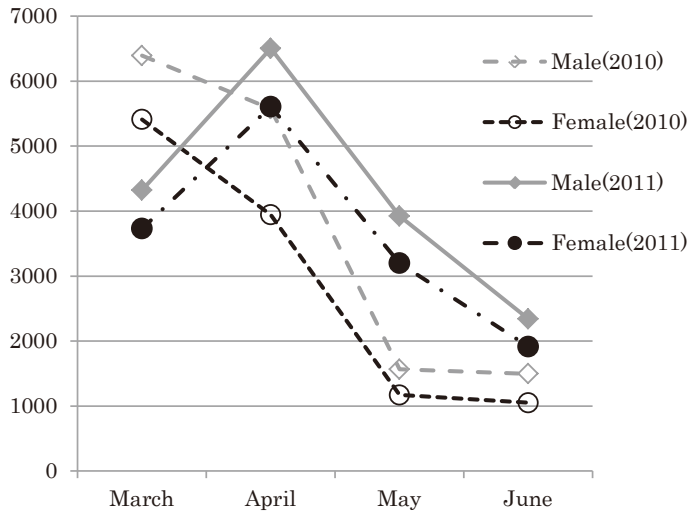

Figure 6 Number of out-migrants (Miyagi)

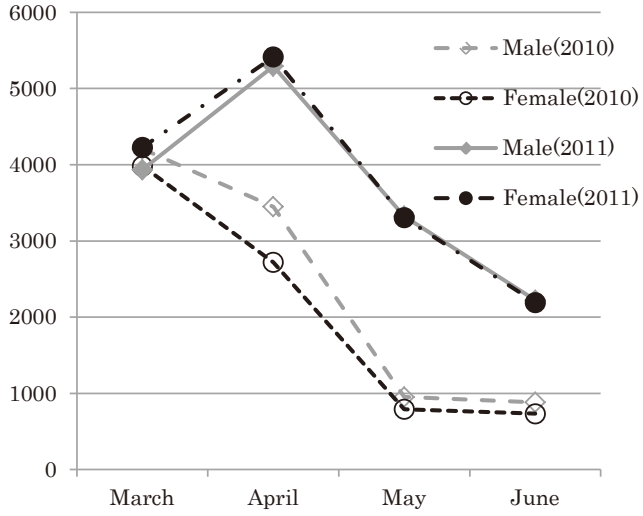

Figure 7 Number of out-migrants (Fukushima)

Metropolitan Area, and the transportation through ordinary roads was possible even just after the earthquake. In addition to it, even though railroads and expressways were blocked, the accident of the nuclear power plant forced many people to move out from Fukushima in a hurry. Because a part of transportation network was recovered in April, the number of the out-migrants greatly increased in these three prefectures. But in Iwate, it was May that the total number of out-migrants overtook the decreased number in March. On the other hand, in Miyagi and Fukushima, the number of out-migrants increased in April greatly, and that tendency continued in May and June. In particular, in Fukushima, it shows that the numbers of the out-migrants of male and female are almost the same. It indicates that the entire family seemed to move out.

2.3. Age profile of out-migrants from each prefecture in the Tohoku Region

Unfortunately, the information about the age structure of out-migrants is not yet released. However, the age structure of net in-migrants (number of in-migrants minus number of out-migrants) has been released recently. Fig. 8 and Fig. 9 show the age structure of net out-migrants ($=-1\times$number of net in-migrants) between March and June in 2010 and 2011 respectively, according to each prefecture of the Tohoku Region.

At first, we will explain the age profiles in 2010 (Fig. 8). As for 5 prefectures of the Tohoku Region excluding Miyagi, we found that the almost same pattern is shown among 5 prefectures. That is, a big excess of out-migrants is shown at the ages of entrance into a university and getting a job from 15 years old to 24 years old. About the other age groups, it can be said that the number of out-migrants is almost the same as the number of the in-migrants. In

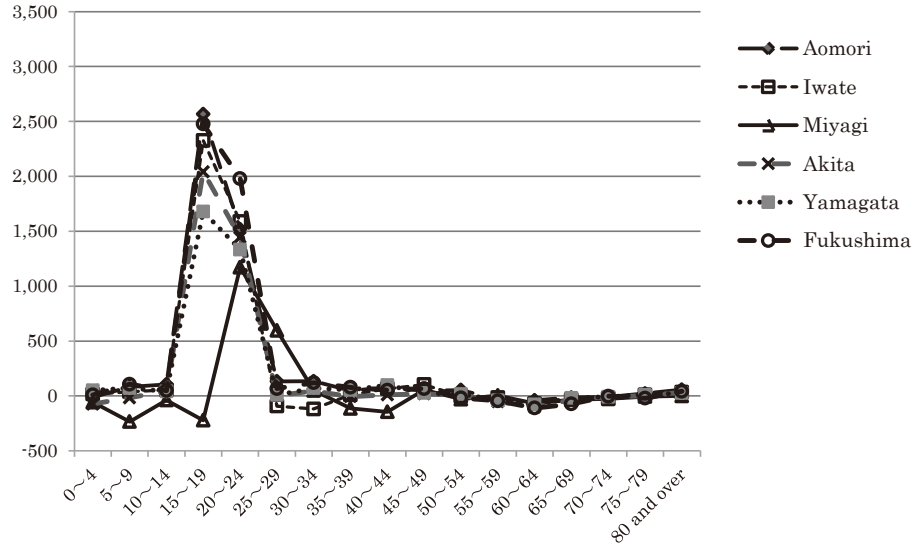

Figure 8 Net out-migrants (total of March-June in 2010)

Iwate, however, we found the excess of in-migrants between the age of 25 to 34 years old, and it seems to be the influence of so-called "U-turn" migration.

On the other hand, in Miyagi, we found an excess of in-migrants in the age group up to 19 years old. One reason of this excess is the in-migration of new students, because there are many universities in Sendai City in Miyagi. In addition to it, excess of in-migrants in the age group from 35 to 44 years old is observed in Miyagi. Then, the children of these people, that is the age groups up to 19 years old, show the excess of in-migrants.

If Fig. 8 shows out-migration pattern in the normal year, the change observed between Fig. 8 and Fig. 9 can be interpreted as the influence of the disaster. We found in Fig. 9 that in four prefectures ; Aomori, Iwate, Akita and Yamagata in the Tohoku Region, the increase in net out-migrants due to the earthquake and tsunami cannot be identified. Rather, in Aomori, Akita and Yamagata, the child generation and his or her parent's generation (from 25 years old to 39 years old) show positive net in-migration, and this can be understood as a result of the migration of entire family from Miyagi and/or Fukushima. On the other hand, in Miyagi and Fukushima, we found a large excess of out-migrants among all the age groups. Especially in Fukushima, there were large excess of out-migrants in the child generation and his or her parent's generation (from 25 years old to 39 years old). In Miyagi, age profile in 2011 shows positive net out-migration even in the age group of 15 to 19 years old which showed positive in-migration in 2010. It is considered as a result of the reduction of in-migrants to enter universities in Miyagi, or a result of the increase of out-migrants to enter universities in other prefectures. In Miyagi and Fukushima, the numbers of net out-migrants of their twenties increased

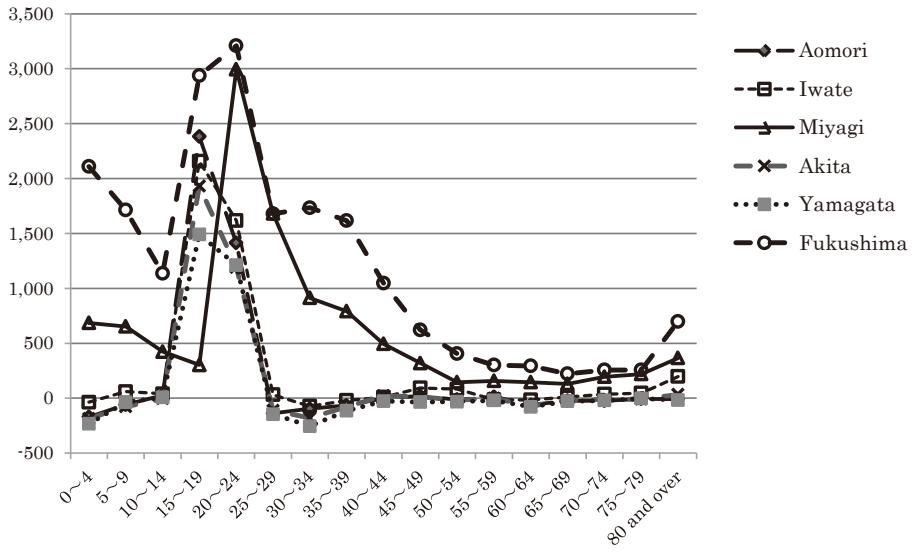

Figure 9 Net out-migrants (total of March-June in 2011)

considerably. It is also a result of the increase of the out-migration to get jobs in other prefectures and a result of the large decrease of in-migrants to get jobs in Miyagi and Fukushima.

2.4. Destination profile of the out-migrants from Fukushima

Finally, we would like to consider the change of destinations of out-migrants from Fukushima where out migration increased sharply to escape from the tsunami damage and the accident of the Fukushima Daiichi Nuclear Power Plant.

We classified destinations into five areas, that is, Miyagi, other Tohoku Region (Aomori, Iwate, Akita, Yamagata), the Tokyo Metropolitan Area (Saitama, Chiba, Tokyo, Kanagawa), other Kanto Region (Ibaraki, Tochigi, Gunma), and Other Regions in Japan.

Fig. 10 shows the number of out-migrants according to destinations, and shows differences between 2010 and 2011. It is clear that the Tokyo Metropolitan Area is the most attractive area to migrate for the out-migrants from Fukushima. While the number of out-migrants to the all destinations increased in 2011, it is clear that the number of out-migrants to "Other Regions" showed the increase in more than twice. Fig. 11 shows the changes of percentage (number of out-migrants to each region×100/total of out-migrants) between 2010 and 2011 according to the destinations for each sex. Comparing 2010 with 2011, while the ratio of the number of out-migrants to farther regions increased considerably, the ratio of the number of out-migrants to Miyagi and the Tokyo Metropolitan Areas decreased. For example, the numbers of out-migrants to the Nagoya Metropolitan Area and the Osaka Metropolitan Area increased more than twice. It can be said that the out-migrants from Fukushima moved out

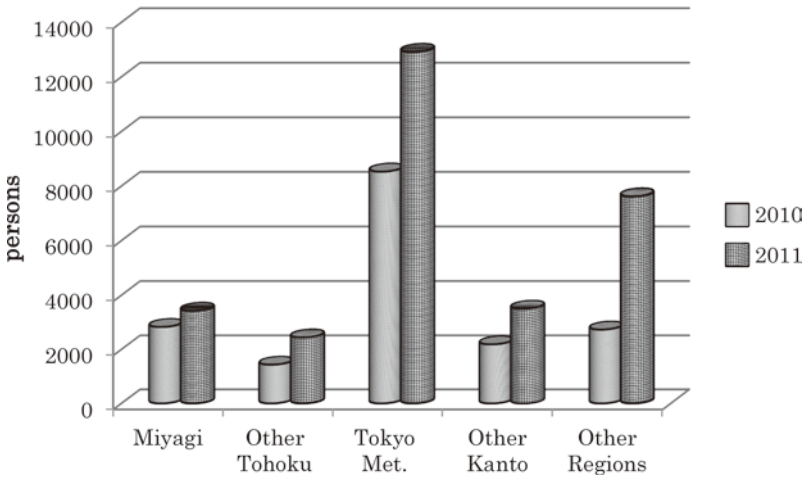

Figure 10 Number of out-migrants from Fukushima by the destination (March-June)

farther after the earthquake and the accident of the Fukushima Daiichi Nuclear Power Plant. When the comparison between male and female is carried out, referring to the movement to Nagoya Metropolitan Area and Osaka Metropolitan Area from Fukushima, the number of male out-migrants increased by almost 2.3 times while that of female increased by almost 3.1 times more than those in 2010. This implicates that women moved farther than men. This can be also the manifestation of the strong desire to avoid the influence and contamination by radiation on women as much as possible.

3. Concluding Remarks

It is a serious problem for the projection of future population of the Tohoku Region whether such a population outflow is temporary or that is not recovered in the future. I would like to consider the population fluctuation of Hyogo Prefecture by the "Great Hanshin-Awaji Earthquake in 1995" as an example of the population fluctuation by natural disaster.

Table 3 shows the change of the number of in-migrants and out-migrants in Hyogo Prefecture for each five years before the "Great Hanshin-Awaji Earthquake" and after the earthquake. As shown in Table 3, Hyogo Prefecture showed about 60,000 people's excess of in-migrants in five years before the earthquake disaster, but within five years after the earthquake disaster, it became about 22,000 people's excess of out-migrants. That is, it can be said that Hyogo Prefecture lost a population of about 80,000 by the earthquake disaster. Even though in Hyogo Prefecture which is located within three major metropolitan areas in Japan, it can be said that the great earthquake brought about the big population outflow under the heavily competitive urban systems in Japan. Furthermore, in the Tohoku Region which is located in the non-

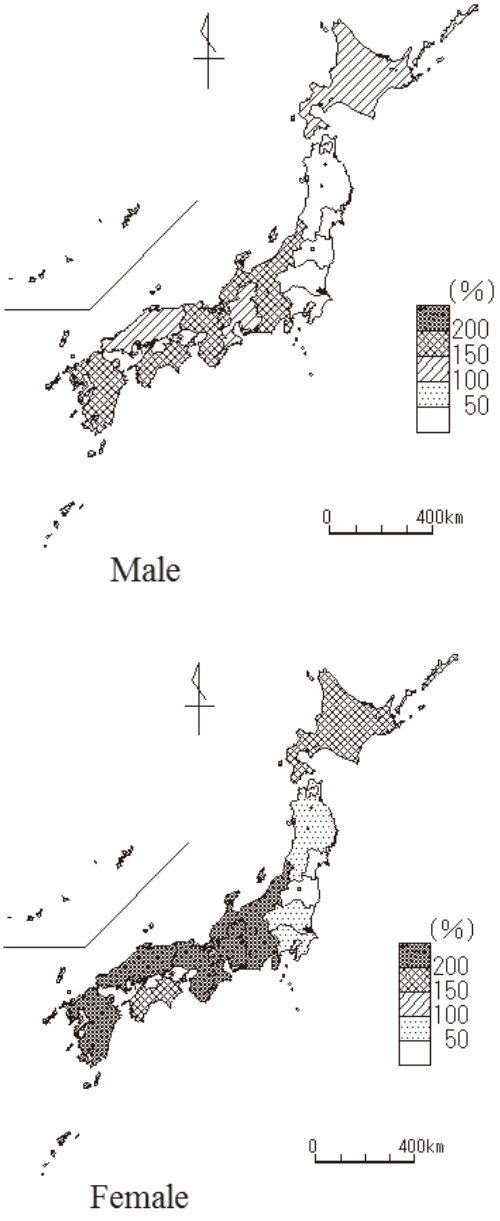

Figure 11 Increase Ratio of Out-migrants from Fukushima (2010-2011)

Table 3 Population movement before and after the Hanshin-Awaji Great Earthquake in Hyogo prefecture

	In-migrants	Out-migrants	Net Migrants
1990～1994	664,688	603,728	60,960
1995～1999	624,988	647,495	−22,507

metropolitan areas and has been influenced by the strong power of population absorption of the Tokyo metropolitan areas, it can be said that it is difficult to escape a large population outflow after the disaster. Besides, in addition to it, there is a possibility that the radioactive contamination by a nuclear power plant accidents may reduce the population carrying capacity of the environment of the Tohoku Region in irreversible form.

According to an population projection by the National Institute of Population and Social Security Reaearch (NIPSSR) by using national census in 2005 as a basic data, it was projected that the ratio of population aged 65 and over will exceeds 40% in about 60% of cities, towns, and villages of the Tohoku Region in 2035. Supposing out-migrated population which has so far been described will not return to their home towns, we have to expect a super-aged society in the Tohoku Region exceeding the estimation of the NIPSSR in the future. In order to prevent a rapid population outflow and super-aging in the Tohoku Region, we need the enforcement of population policy which includes the change of an immigration policy in the future.

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